



Micro Air Vehicles



Defense Science & Technology Seminar on Emerging Technologies

Sponsored by the
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Science & Technology
and the
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Arlington Hilton & Towers
950 North Stafford Street
Arlington, VA 22203
(Ballston Metro Stop)

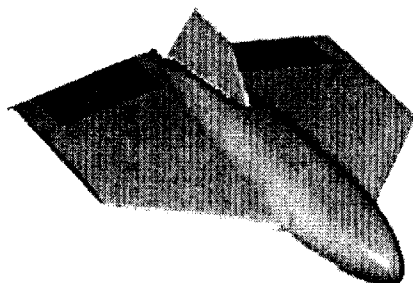
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Micro Air Vehicles

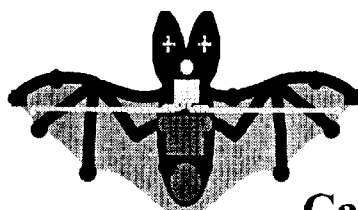


MicroSTAR

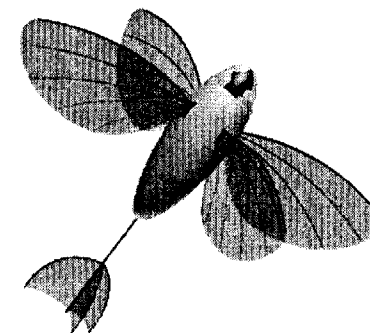
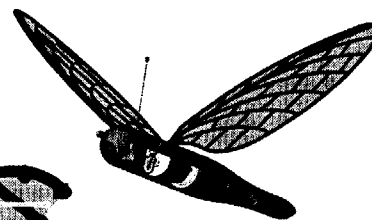


Lockheed Sanders

Microbat

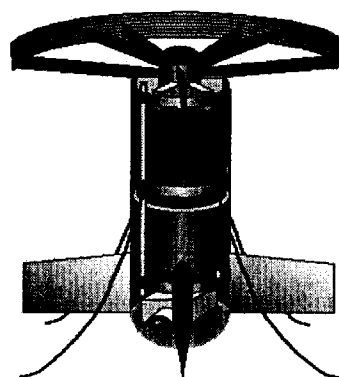


Caltech



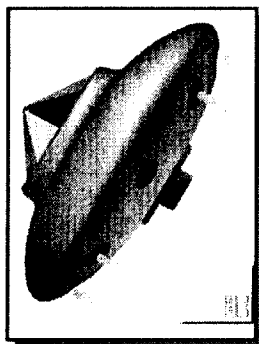
Stanford Research Institute

Kolibri



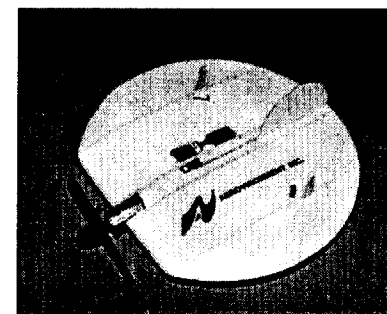
Lutronix

HIPERAV



Aerodyne

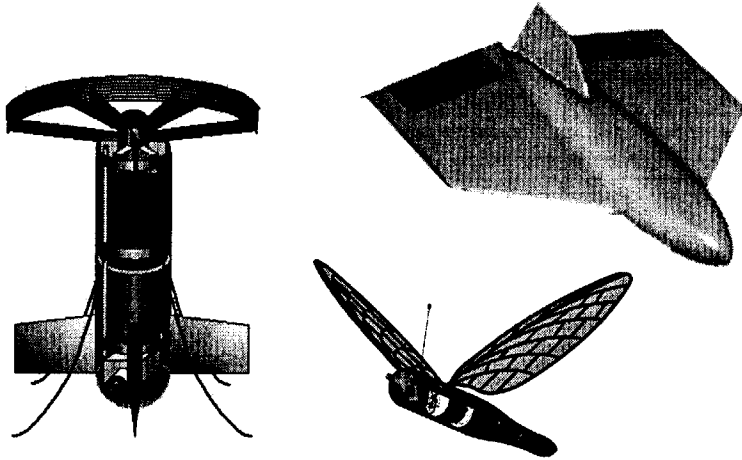
Black Widow



AeroVironment



Micro Air Vehicles



What is a Micro Air Vehicle?

- n Small Air Vehicle No Larger Than 15 cm. in any dimension.
- n Capable of Performing a Useful Military Mission at an Affordable Cost.

Technical Objectives:

- n Develop Flight Enabling Technologies
- n Develop and Demonstrate Micro Air Vehicles Capable of Sustained Flight and Useful Military Missions

Military Relevance:

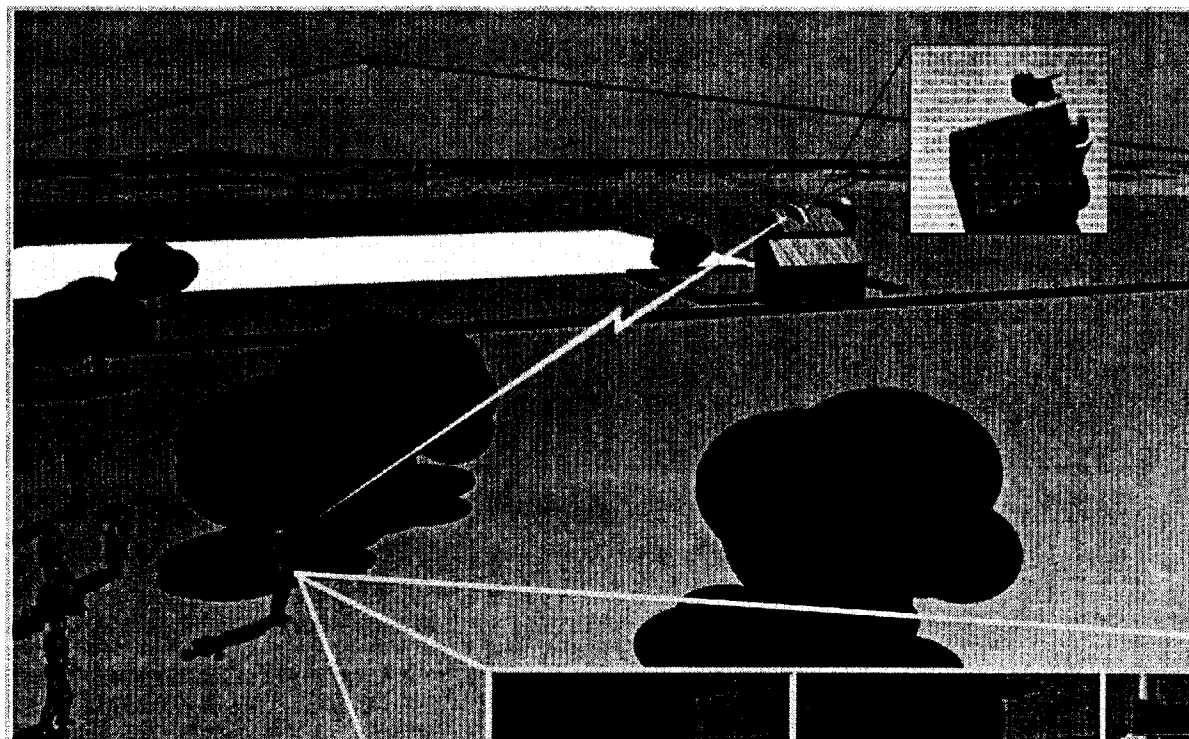
- n Local, On-Demand Situational Awareness for Small Units
 - ┆ Recon., Bio-chem. detection, acoustic, ...
- n Enables New Missions in Emerging Warfighting Environments
 - ┆ Urban operations, building interiors
- n Potential Users: Army, Marines, Air Force, Navy, Special Operations Forces



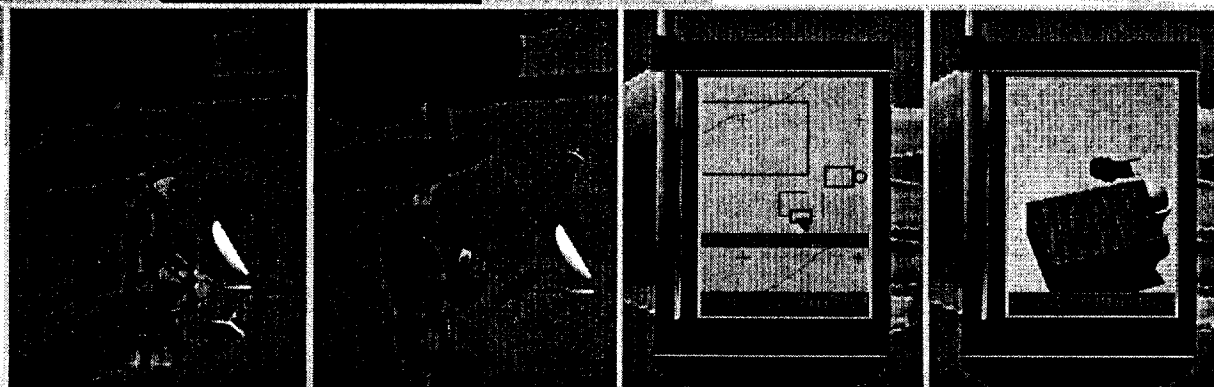
MAV Provides "Over-the-Hill" Reconnaissance



- MAVs are Fully Functional Military Air Vehicles
- Local situational awareness for small units
 - Platoon level asset
 - Eliminates latency
- 30-60 minutes, 1-10 km
- Day/night imaging

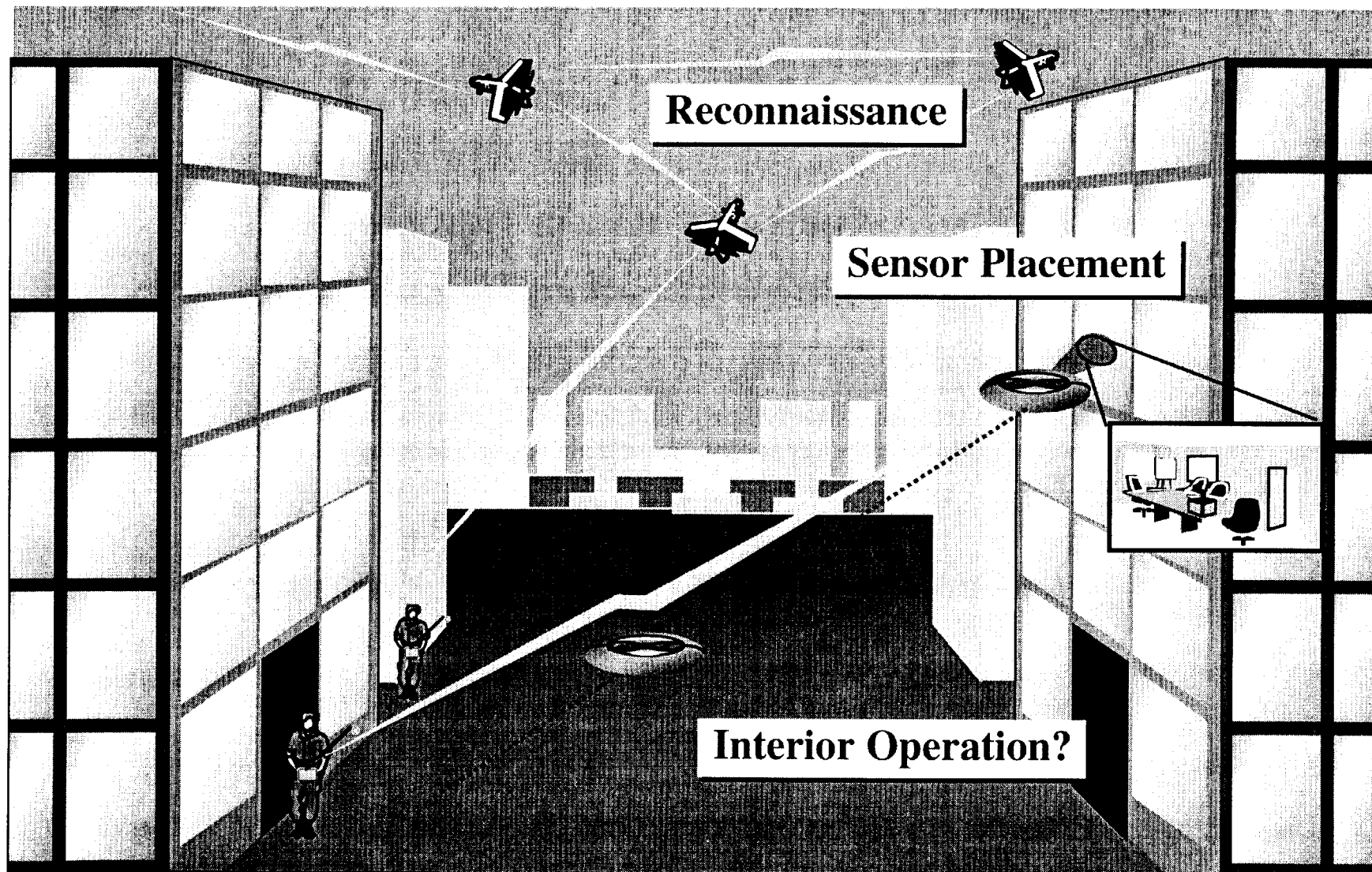


Easy to Operate
Low Cost
Ammo-like packaging





MAVs for Urban Operations





Why Micro?



- ❑ **Organic Asset, Eliminates Latency**
- ❑ **Enables Completely New Missions**
 - Urban canyons, building interiors, ...
- ❑ **Vehicle weight - Trades with Water, Ammo, ...**
- ❑ **Eliminates Logistics Tail**
- ❑ **Affordable (Even Attritable)**
- ❑ **Hard to Detect**
- ❑ **A DARPA-Hard Problem**



MAV Propulsive Power



Component Size, Weight, and Power Requirements Must be Minimized

Maximize Endurance Parameter

- Maximize Aerodynamic Performance
- Thin cambered airfoils (low Re)

Maximize Propeller Efficiency

- Optimized size, speed & type may not suit operational needs

$$\text{Power to fly} = W \left[\frac{C_D}{C_L^{3/2}} \right] \left[\frac{W}{S} \right]^{1/2} \left[\frac{2}{\rho} \right]^{1/2} / \eta$$

Minimize Weight

- component synergy
- microfabrication
- reduce fuel load
- maximize propulsion system energy density
- minimize payload

Minimize Altitude

Minimize Wing Loading

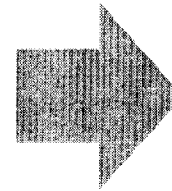
- minimize wing loading
- large wing area
- low aspect ratio



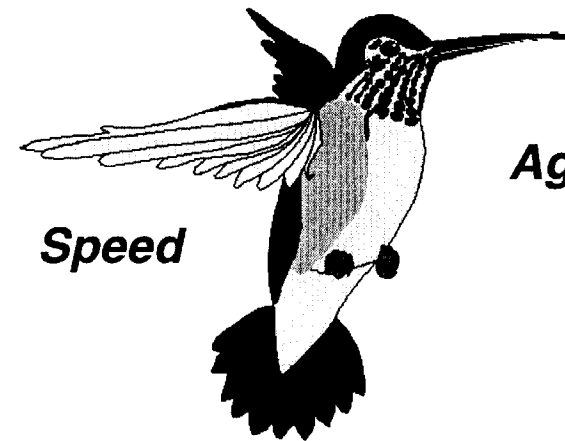
Technical Challenges



- Low Re Aerodynamics and Propulsion
- Light WeightPower and Propulsion
- Ultra-light sensors and communications
- Autonomy, navigation, guidance and control



Range



Agility

Speed

Coverttness

Hover

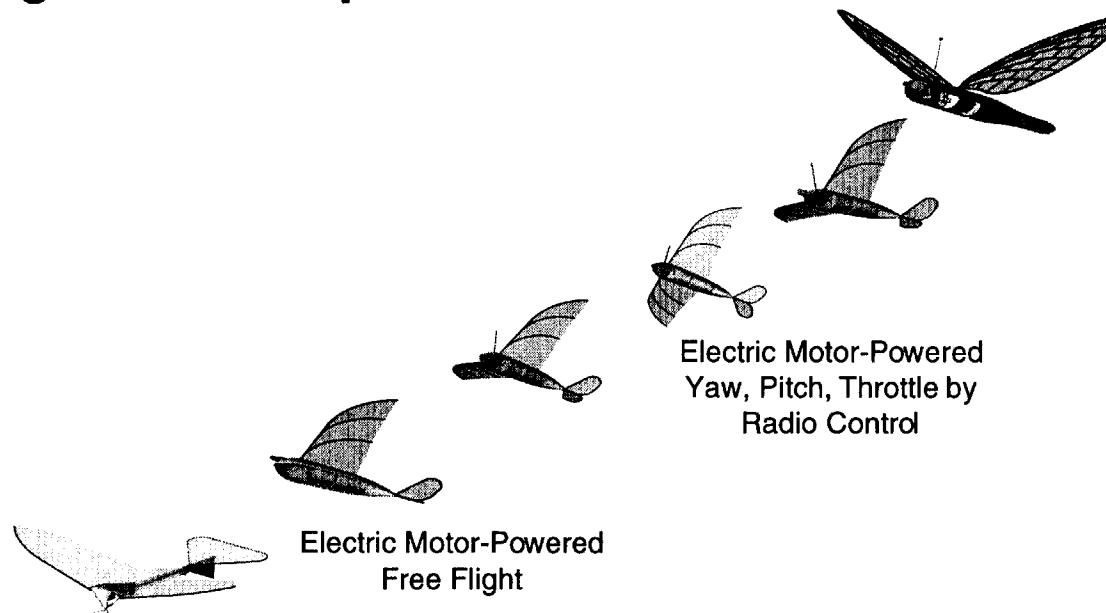
High Degree of Integration and Multifunctionality



Evolution of Micro Air Vehicles



- Interest is growing exponentially
- Technical options increasing over time
- As functional capability evolves, so does operational spectrum
 - Balancing the two is a continuing challenge
- Creating realistic expectations



Final Vehicle: MEMS
Structure, Acoustic Nav,
Imaging Payload
With Downlink,
Auto Stability,
Radio Command